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SPECIFICATION FOR LUBRICANTS FOR CLOCK LIKE MECHANISMS AND PRECISION INSTRUMENTS

(Second Revision)

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MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 4 *December* 1987

AMENDMENT NO. 1 JULY 1996
TO
IS 1088 : 1987 SPECIFICATION FOR LUBRICANTS FOR CLOCK LIKE MECHANISMS AND PRECISION INSTRUMENTS

(Second Revision)

[*Page* 5, *Table* 1, *Sl No.* (vii), *col* 3] — Substitute the following for the existing:

'– 39°C'

(PCD 4)

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SPECIFICATION FOR LUBRICANTS FOR CLOCK LIKE MECHANISMS AND PRECISION INSTRUMENTS

(Second Revision)

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(*Continued on page* 15)

Indian Standard

SPECIFICATION FOR LUBRICANTS FOR CLOCK LIKE MECHANISMS AND PRECISION INSTRUMENTS

(Second Revision)

0. FOREWORD

0.1 This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards on 2 September 1987, after the draft finalized by the Lubricants and Related Products Sectional Committee had been approved by the Petroleum, Coal and Related Products Division Council.

0.2 This standard was originally published in 1957 and subsequently amended in 1965 and 1966. It was first revised in 1975. The 1957 version covered oil intended to be used for the lubrication of watches, clocks, chronometers and other delicate instruments which are liable to be exposed to wide range of ambient temperature. The 1975 revision was taken up to cover improved quality of material then available in the country. In the present revision, the title of the specification has been changed, various test methods have been modified and new tests have been incorporated. This revision is mainly based on the recommendations made by the *Ad hoc* Study Group for review of published Indian standards for speciality products.

0.3 In the preparation of this revision, considerable assistance has been derived from the following publications:

a) US Army Specification No. 2-47P Oil, clock and watch; and

b) Report submitted by Mr Treboux of M/s H. Moebius & Fils, Switzerland, on testing of various watch oil samples as well as his review of IS : 1088-1975.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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*Rules for rounding off material values (*revised*).

1. SCOPE

1.1 This standard prescribes the requirements, and methods of sampling and test for lubricants intended for the lubrication of clock like mechanisms and precision instruments.

2. REQUIREMENTS

2.1 Description — The oil shall be a synthetic product. It shall be clear, homogenous, free from water and impurities, chemically stable, and non-corrosive to ferrous and non-ferrous metals and combinations thereof.

2.2 The material shall also comply with the requirements prescribed in Table 1 when tested according to the methods prescribed in the appendices to this standard and the test methods laid down under the 'P' series of IS : 1448*. Reference to the relevant appendices and designations of test methods are given in columns 4 and 5 of Table 1.

3. PACKING AND MARKING

3.1 Packing — The material shall be packed in securely closed containers or any other suitable containers as agreed to between the purchaser and the supplier.

3.2 Marking — The containers shall be marked with the name of the material; name of the manufacturer and his trade-mark, if any; batch or code number, and year and country of manufacture.

3.2.1 The containers may also be marked with the Standard Mark.

NOTE — The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions, under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

4. SAMPLING

4.1 Representative samples of the material shall be drawn as prescribed in IS: 1447-1966†.

4.2 Each test shall be conducted separately using fresh sample of the oil. A 250 ml quantity of the oil shall be sufficient for all the tests.

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*Methods of test for petroleum and its products.

†Methods of sampling of petroleum and its products.

TABLE 1 REQUIREMENTS FOR LUBRICANTS FOR CLOCK LIKE MECHANISMS AND PRECISION INSTRUMENTS

(*Clause* 2.2)

SL No.	CHARACTERISTICS	REQUIREMENTS	APPENDIX	METHODS OF TEST REF TO IS : 1448*
(1)	(2)	(3)	(4)	(5)
i)	Kinematic viscosity, in cSt at:		—	P : 25
	a) 40°C, *Min*	30·0		
	b) 0°C, *Max*	330·0		
	c) −35°C, *Max*	10 000·0		
ii)	Viscosity index, *Min*	125	—	P : 56
iii)	Oxidation stability, changes after test:		A	—
	a) Appearance	No turbidity or sediment		—
	b) Kinematic viscosity at 40°C, percent, *Max*	10		P : 25
	c) Peroxide number	Not more than 5	B	—
	d) Organic acidity	Not more than 10 percent of the original	—	P : 2
	e) Copper spiral	No sign of corrosion	—	—
iv)	Evaporation loss, percent by mass, *Max*	1	C	—
v)	Adherence to metal, change in diameter of the drop, percent, *Max*	15	D	—
vi)	Protection:		E	—
	a) Appearance of oil	No appreciable change in colour when compared with the original oil		
	b) Steel cube	No corrosion		
	c) Brass cube	No discolouration or corrosion		
vii)	Pour point, *Max*	−40°C	—	P : 10
viii)	Acidity		—	P : 2
	a) inorganic	Nil	—	
	b Organic (mg of KOH/g of the oil), *Max*	1·0		
ix)	Lubricity (coefficient of friction), *Max*		F	—
	a) Steel/steel	0·155		
	b) Steel/ruby	0·135		

*Methods of test for petroleum and its products.

4.2.1 If the unit pack gives a quantity less than the minimum quantity required for tests, minimum multiple number of unit packs shall be taken as one sample.

APPENDIX A

[*Table* 1, *Sl No.* (iii)]

DETERMINATION OF OXIDATION STABILITY

A-1. SPECIAL APPARATUS

A-1.1 The apparatus (*see* Fig. 1) consists of a glass tube A of 270-mm length and 25 mm inside diameter with a glass tube B of 4 mm inside diameter sealed to bottom to provide for the entrance of oxygen. The top of tube A has a standard B 24 ground-glass socket joint fitted with a condenser.

A-2. METAL CATALYST

A-2.1 Copper Spiral — made of copper wire conforming to IS : 191-1967*.

Total length of the copper wire = 300 mm
Diameter of the copper wire = 2 mm
No. of coils in the spiral = 8

A-3. PREPARATION OF METAL CATALYST

A-3.1 Chemical cleaning of copper spiral according to ASTM method D-1261 given under preparation of strips (Method B).

A-4. PROCEDURE

A-4.1 Transfer 50 ml of the test oil in the glass test tube A. Place the metal catalyst (copper spiral) in the oil. Place the tube containing the oil and the catalyst, fitted with a condenser in a thermostat maintained at 100 ± 1°C for 100 h. Bubble in dry oxygen at a rate of 2 to 3 bubbles per second through the oil by means of glass tube B (*see* Fig. 1). At the end of the test period:

a) Observe the appearance of the oil,
b) Determine the viscosity of the oil at 40°C,

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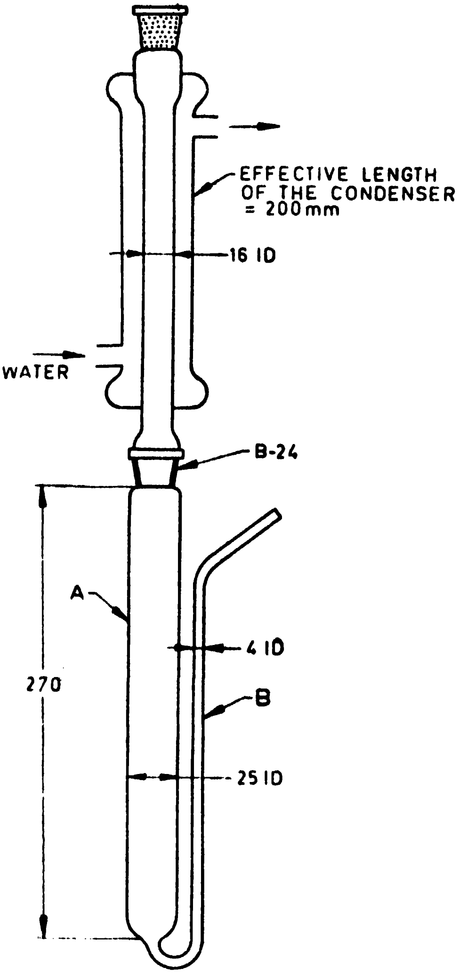
*Specification for copper (*second revision*).

c) Determine the peroxide number of the oil,

d) Determine the organic acidity of the oil, and

e) Wash the copper spiral with sulphur free toluene followed by petroleum hydrocarbon solvent (40/60) (*see* IS : 1745-1975*) and examine the catalyst visually for any corrosion.



All dimensions in millimetres.

FIG. 1 APPARATUS FOR THE DETERMINATION OF OXIDATION STABILITY

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*Specification for petroleum hydrocarbon solvents (*second revision*).

APPENDIX B

[*Table* 1, *Sl No.* (iii) (c)]

DETERMINATION OF PEROXIDE NUMBER

B-1. SUMMARY

B-1.1 A suitable quantity of sample is dissolved in carbon tetrachloride and acidified with acetic acid solution. A solution of potassium iodide is added and after a reaction period, the solution is titrated with sodium thiosulphate solution to the end point indicated by the colour change of added starch solution.

B-2. REAGENTS

B-2.1 Acetic Acid, Glacial — 99 percent.

B.2.2 Carbon Tetrachloride (CCl_4)

B-2.3 Potassium Dichromate, Standard Solution (0·1 N) — Recrystallize potassium dichromate ($K_2Cr_2O_7$) twice from an aqueous solution and dry at about 165°C to constant mass Dissolve 2·452 g of the purified $K_2Cr_2O_7$ in water and dilute to 500 ml in a volumetric flask.

B-2.4 Potassium Dichromate, Standard Solution (0·01 N) — Dilute 100-ml of 0·1N $K_2Cr_2O_7$ solution with water to 1 000-ml in volumetric flask.

B-2.5 Potassium Iodide Solution — Prepare a fresh solution by dissolving 10 g of potassium iodide free from potassium iodate in 100-ml of water.

B-2.6 Starch Solution — Make a paste of 0·5 g of soluble starch in cold water, pour in 100-ml of boiling water, boil for 5 minutes, cool and bottle. The solution should be prepared afresh every two or three days.

B-2.7 Standard Sodium Thiosulphate Solution (0·1 N) — Dissolve 12·0 g of sodium thiosulphate ($Na_2S_2O_8 \cdot 5H_2O$) and 0·1 g of sodium carbonate (Na_2CO_3) in 500 ml of water. Let it stand for a week or more before using. Standardize against 0·1N $K_2Cr_2O_7$ solution. Restandardize at intervals frequent enough to detect changes of the order of 0·000 5 in normality.

B-2.8 Standard Sodium Thiosulphate Solution (0·005 N) — Dilute 100 ml of 0·1 N $Na_2S_2O_3$ solution with water to 2 000 ml in volumetric flask. Standardize against 0 01N $K_2Cr_2O_7$ solution.

B-3. PROCEDURE

B-3.1 Weigh to the nearest 1 ± 0·2 g of the sample into a weighed iodine flask. To the flask add 25 ml carbon tetrachloride (CCl_4) and quickly dissolve the sample and then add 20 ml of acetic acid. Add 2 ml of potassium iodide (KI) solution and swirl vigorously for exactly 30 seconds. Keep the stoppered flask in a dark place for 30 minutes. Add 100-ml of distilled water and mix thoroughly for a minute. Titrate it with 0·005 N sodium thiosulphate ($Na_2S_2O_3$) solution to a light yellow colour. Add 5 ml of starch solution and continue the titration until the blue colour disappears and does not reappear for 30 seconds or longer.

B-3.2 Make a blank determination on the reagents. Proceed as directed in **B-3.1** except to omit the sample.

B-4. CALCULATION

B-4.1 Calculate the peroxide number as milliequivalents per 1 000 g of sample as follows:

$$\text{Peroxide Number} = \frac{(A - B)\,N \times 1\,000}{M}$$

where

A = volume of $Na_2S_2O_3$ solution, in ml, required for titration of the sample;

B = volume of $Na_2S_2O_3$ solution, in ml, required for blank titration;

N = normality of the $Na_2S_2O_3$ solution; and

M = mass of the sample used in g.

APPENDIX C

[*Table* 1, *Sl No.* (iv)]

DETERMINATION OF EVAPORATION LOSS

C-1. PROCEDURE

C-1.1 Transfer 5 ml of the oil in a pre-weighed glass beaker of about 30-ml capacity so that the exposed area of the oil is about 8 cm^2. Again weigh the beaker with the oil. Maintain the temperature of the assembly at 70 ± 1°C for 10 days in an oven where the only air currents are those of natural convection. At the end of this period, the beaker shall be cooled in a desiccator and weighed again. Calculate the loss in mass as percentage of the mass of the material taken for the test.

APPENDIX D

[*Table* 1, *Sl No.* (v)]

TEST FOR ADHERENCE TO METAL

D-1. PREPARATION OF TEST SPECIMEN

D-1.1 Prepare a test specimen approximately 12×12×3 mm from mild steel (conforming to Designation St 42-S of IS : 226-1975*). Round both sides of the test specimen at the edges and buff them free of rust on a built up glued, alundum polishing wheel or equivalent, followed by sand blasting, to a fresh uniformly abreded surface, using sand which is practically white in colour, sharp, dry and free from organic matter. (The fineness of the sand shall be such that all shall pass through 1·70 mm IS Sieve, and not more that 10 percent shall fail to pass through 850-micron IS Sieve, and not more than 10 percent shall pass through 300-micron IS Sieve.) Handle the test specimen during or subsequent to the sand blasting operation with clean and dry forceps contacting the edges only, Following the sand blasting, free the test specimen of all dust by blowing with filtered dry air and protect from dust. Polish the test specimen with a series of abrasive papers down to 0 000 metallographic paper, finished by polishing with Fisher's No. 3 polishing alumina or its equivalent to a metallographic polishing wheel. After polishing, wash the test specimen with boiling sulphur-free toluene twice followed by petroleum hydrocarbon solvent (40/60) *see* IS : 1745-1978† twice. Place the test specimen in an oven at 100 ±1°C for 15 minutes for drying. Remove the test specimen from the oven and allow to cool in a desiccator over silica gel until ready for use.

D-2. PROCEDURE

D-2.1 Place three drops of the oil approximately 1 mm in diameter, on the test specimen, with the help of flat end of platinum wire taking care that the end of the wire does not touch the test specimen. Two drops should preferably be placed near each of opposite corners of the test specimen and the third drop should be in the centre. Place two drops of tricresyl phosphate near to the remaining two opposite corners of the test specimens in the same manner. Cover the surface and drops to keep out dust and let stand for 15 minutes. Measure the initial diameter of all the five drops after 15 minutes of placing the drops over the test specimen with the help of micrometer eye piece microscope or by other suitable means with an accuracy of the one percent. Cover the test specimen and

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*Specification for structural steel, standard quality (*fourth revision*).

†Specification for petroleum hydrocarbon solvent (*second revision*).

place horizontally in the oven maintained at 38 ± 1°C. Examine the drop after 24 hours. If the oil spreads more than 15 percent (stipulated), while tricresyl phosphate does not, the oil does not pass the test. If both the oil and tricresyl phosphate drops are spreading more than 15 percent, the surface is not prepared adequately and test should be repeated on a freshly prepared test specimen in the manner stated above till no spreading with tricresyl phosphate drops is observed. In case of no evidence of spreading, continue the test and measure the diameter of the drops after a period of 30 days. Calculate the change in diameter of each drop as percentage of the diameter of the drops before heating.

APPENDIX E

[*Table* 1, *Sl No.* (vi)]

TEST FOR PROTECTION

E-1. PREPARATION OF TEST

E-1.1 Polish a mild steel (conforming to Designation St. 42-S of IS : 226-1975*) cube 25 × 25 × 25 mm and a brass cube (25 × 25 × 25 mm) with emery paper (No. 00) to not more than 0·254 micron surface finish and then clean first with boiling sulphur-free toluene twice followed by hot petroleum hydrocarbon solvent (40/60) (*see* IS: 1745-1978†) twice. Dry in an oven at 100 ± 1°C for 15 minutes. Cool in a desiccator over silica gel until ready for use.

E-2. PROCEDURE

E-2.1 Smear all the surfaces of test specimen with the test oil by putting the metal piece in a clean and dry 50-ml beaker with well cleaned tongs without touching by hand and pouring about 3 ml of the oil over the test specimen by rotating the beaker. Take out the test specimen and keep it in inclined position over the hole of porcelain plate kept in the desiccator whose lower part is half filled with water. Cover the desiccator with its lid and keep it in a chamber at 25 ± 1°C for 30 days. Examine the test oil for any change in colour and the test specimen for any evidence of corrosion.

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*Specification for structural steel, standard quality (*fourth revision*).

†Specification for petroleum hydrocarbon solvent (*second revision*).

APPENDIX F

[*Table* 1, *Sl No*. (ix)]

TEST FOR LUBRICITY (COEFFICIENT OF FRICTION)

F-1. EQUIPMENT

F-1.1 The Oiliness Testing Machine (Pendulum Friction Type) or the Soda Pendulum Lubricity Tester* is used (*see* Fig. 2). The machine consists of a T-type pendulum (A) fitted with a roller pin (B), which is supported on four balls (C). The contact points are placed in a Case (D), which is lubricated with the test oil. The pendulum (A) has one counter mass (M_1) on the central vertical arm and two counter masses (M_2) at both the ends on the horizontal arm. The pendulum can be swung precisely by means of a hand lever (E). The swing is measured on a graduated scale (F) fitted on the machine.

F-2. TEST CONDITIONS

F-2.1 The following test conditions are used:

a) Room temperature — 25 ± 5°C

b) Relative humidity — 70 ± 5 percent

c) Steel balls (4·8 mm dia, conforming to JIS B 1501, supplied along with the equipment).

d) Roller pin (2 mm dia and 30 mm long, conforming to JIS G 4805 with hardness HRC 60-66, supplied along with the equipment).

e) (1) Counter mass (M_1) on the vertical arm — 40 g (1 pc)

(2) Counter mass (M_2) on the horizontal arm — 80 g (2 pcs)

(3) Set position of counter mass M_1 (L_1) — 100 mm

(4) Set position of counter mass M_2 (L_2) — 340 mm

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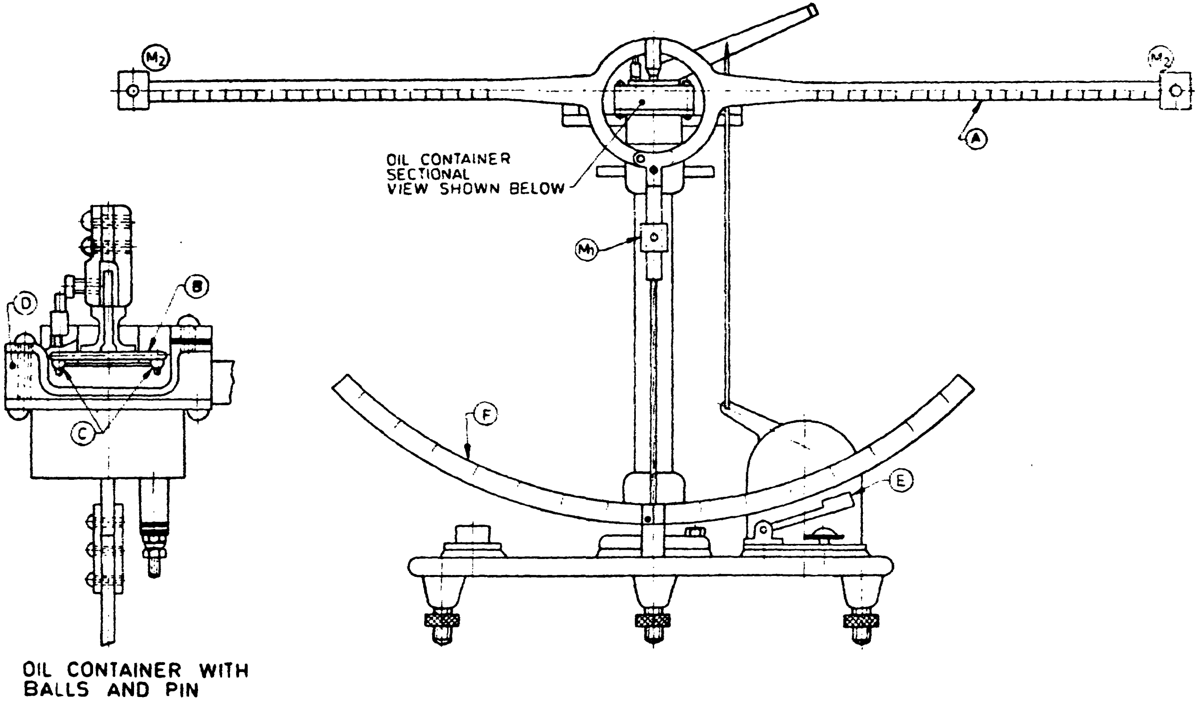
*Model N-II manufactured by Shinko Engineering Co Ltd, Ogaki, Japan.



A — T-Type Pendulum
B — Roller Pin
C — Balls
D — Case
E — Hand Lever
F — Graduated Scale
M_1 — Counter Mass
M_2 — Counter Mass

FIG. 2 A TYPICAL SODA PENDULUM LUBRICITY TESTER

F-3. PROCEDURE

F-3.1 The oil case (D) is cleaned with petroleum hydrocarbon solvent (40/60) (*see* IS : 1745-1978) prior to the starting of the test. A new set of four balls (C) (steel or ruby) and roller pin (B) are washed and placed in the central test oil cup (D) and the centre of the pendulum respectively. A special care is required in cleaning and handling of the balls for better and reproducible results. A quick drying petroleum hydrocarbon solvent (40/60) has been found satisfactory for cleaning the balls. The cleaned balls should be air dried and handled with cleaned and dried forceps only. At no time the balls should be touched with fingers.

F-3.2 One or two drops of the test oil are placed on the two ball pairs after placing and locking them in the oil cup. The pendulum with pin is then placed in its position over the balls. Counter mass M_1 is maintained at 40 g at the set position 100 mm (L_1) and counter mass M_2 is mantained at 80 g at the set position 340 mm (L_2). The pendulum is adjusted to 0·5 radian amplitude by pressing the lever (E). The lever is then released instantly and pendulum is set to oscillate. The amplitude of the pendulum is noted after every three cycles till it comes to rest.

F-3.3 The oil film, placed at the contact point, is made to spread by repeating the swinging of the pendulum. The damping characteristics of the pendulum (namely, the number of cycles before the pendulum comes to a stop) is then determined at the 60th swing. This is taken as the lubricity index of the test oil.

F-3.4 For the above combination of mass (M_1 and M_2), the coefficient of friction (f) is given by:

$$f = \text{Constant} \times \frac{A_o - A_n}{N}$$

where

Constant = 3·2

A_o = 0·5 (initial amplitude)

A_n = Amplitude after 3 cycles

N = Number of cycles (3)

$$\text{So, } f = 3{\cdot}2 \times \frac{0{\cdot}5 - A_n}{3}$$

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*Specification for petroleum hydrocarbon solvent (*second revision*).

(*Continued from page* 2)

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*Sales Office in Bombay is at Novelty Chambers, Grant Road, Bombay 400007 — 89 65 28

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